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May 3, 2019

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Notice of *Ex Parte* Presentation, IB Docket No. 11-109, RM-11681, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091

Dear Ms. Dortch:

On May 2, 2019, Valerie Green, Executive Vice President and Chief Legal Officer of Ligado Networks LLC ("Ligado"), Justin Lilley of TeleMediaPolicy Corp., and the undersigned met by telephone with Aaron Goldberger, Acting Wireless Advisor to Chairman Pai. The parties discussed the attached presentation which highlights the critical importance of lower mid-band spectrum such as Ligado's to the future of 5G.

The Ligado representatives commended the Commission for moving forward with a Notice of Proposed Rulemaking ("NPRM") to reallocate the 1675-1680 MHz band from exclusive use by federal users to shared use between those federal operations and new, non-federal terrestrial wireless use,[1] and for proposing generally the same service rules as those that apply for the 1670-1675 MHz band. They noted two proposals in the Draft NPRM that merit closer attention: the proposal to license the band on a partial economic area ("PEA") basis rather than to offer a national license and the proposal to use the spectrum as only a downlink band. The Ligado representatives explained how the 1675-1680 MHz band could be used more efficiently if the final NPRM considers rules more closely aligned with those for the 1670-1675 MH band.

In addition, the Ligado representatives noted that while the President's budget regarding the 1675-1680 MHz band, the Chairman's announcement of the Draft NPRM, and the

[1] *See In the Matter of Allocation and Service Rules for the 1675–1680 MHz Band*, Draft Notice of Proposed Rulemaking, WT Docket No. 19-116 (rel. Apr. 18, 2019), *available at* https://docs.fcc.gov/public/attachments/DOC-357088A1.pdf ("Draft NPRM").

"Background" discussion in the Draft NPRM reference the idea of using "either auction or use fee authority to assign spectrum frequencies between 1675–1680 megahertz for flexible use by 2020, subject to sharing arrangements with Federal weather satellites,"[2] the Draft NPRM does not discuss the concept of assignment with a fee as a possible licensing mechanism. The Ligado representatives suggested that, consistent with the Presidential Budget and the Chairman's announcement, the NPRM should seek comment on the possibility of assigning the spectrum for a fee under the Commission's Section 316 authority, in the event the Commission determines that outcome is consistent with the public interest.[3]

The parties also noted that the Commission has opted in other circumstances to establish flexible spectrum rules for bands which were significantly encumbered and then hold an auction with a substantial reserve price.[4] In order for the Commission to have a full record to choose the appropriate assignment methodology, we respectfully recommended that the NPRM ask for comment on these various options.

Lastly, the parties discussed how the proposal to reallocate the 1675-1680 MHz band to shared terrestrial use is an essential component of the plan to make 40 megahertz of lower mid-band spectrum available for 5G services.

Separately, the undersigned spoke via phone with Charles Mathias, Associate Bureau Chief of the Wireless Telecommunications Bureau ("WTB"), regarding the Draft NPRM's indication that new licensees in the 1675-1680 MHz band must successfully coordinate their base station operations with Federal Government entities operating meteorological satellite Earth-station receivers within *"11"* protection zones.[5] It was noted that this number conflicts with the reference to *"14"* protection zones in paragraph 8 of the Draft NPRM. In light of the fact that the reference to 14 protection zones in paragraph 8 stems from the list of sites set out in Footnote US88 in the U.S. Table, it appears that the reference to 11 protection zones in proposed rule Section 27.1410(a) is a typographical error and it should read *"14."*

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[2] Office of Mgmt. & Budget, Exec. Office of the President, Budget of the United States Government, Fiscal Year 2020 (2019), at 10, *available at* https://docs.fcc.gov/public/attachments/DOC-356607A2.pdf; Ajit Pai, *Fast, Reliable, and Secure*, FCC Blog (Apr. 17, 2019), https://www.fcc.gov/news-events/blog/2019/04/17/fast-reliable-and-secure; Draft NRPM at 3, ⁋ 5.

[3] *See, e.g., Improving Public Safety Communications in the 800 MHz Band*, Report and Order, 19 FCC Rcd 14969 ¶¶ 64-69 (2004) (finding that the Commission had the legal authority to assign to Nextel spectrum in the 1.9 GHz band for a fee); *Mtel v. FCC*, 77 F.3d 1399 (D.C. Cir. 1996) (upholding Commission's authority to require payment for spectrum assignment).

[4] *See Auction of H Block Licenses in the 1915-1920 MHz and 1995-2000 MHz Bands Scheduled for January 14, 2014; Notice and Filing Requirements, Reserve Price, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 96*, Public Notice, 28 FCC Rcd 13019, 13064 ¶¶ 114, 169-74 (WTB 2013) (setting certain flexible rules for the H Block auction and establishing a reserve price of $1.564 billion).

[5] *See* Draft NPRM at 35 (Appendix A) (setting out proposed rule § 27.1410(a)).

Please direct any questions to the undersigned.

Sincerely,

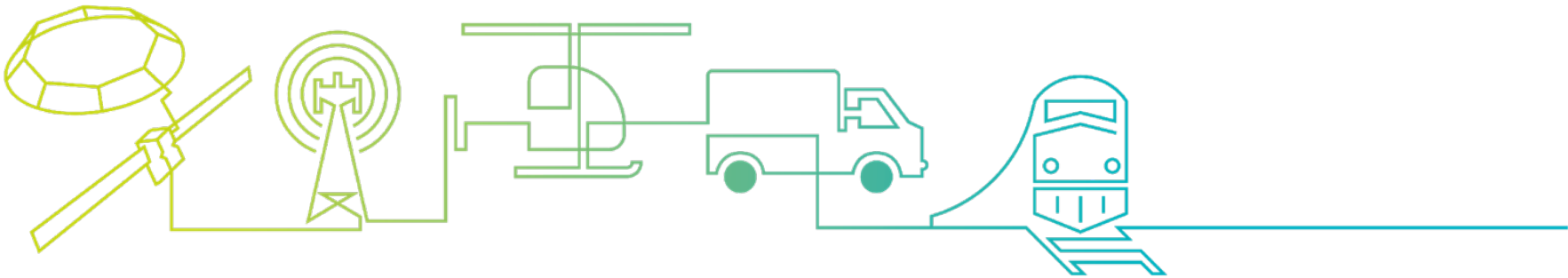
/s/
Gerard J. Waldron
Counsel to Ligado Networks LLC

Attachment

cc: Aaron Goldberger
Erin McGrath
Will Adams
Umair Javed
Randy Clarke
Charles Mathias
Paul Powell
Anna Gentry
Becky Schwartz

Ligado Networks: Facilitating a 5G Future with Mid-Band Spectrum

MAY 2, 2019



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Discussion Overview

- 5G and Ligado Networks' Mid-Band Spectrum
- 1675-1680 MHz Can be Shared and NOAA's Operations Fully Protected
- Lower Mid-Band Spectrum Plays a Critical and Complementary Role in 5G
- Ligado Has Resolved All Concerns Raised in the Record

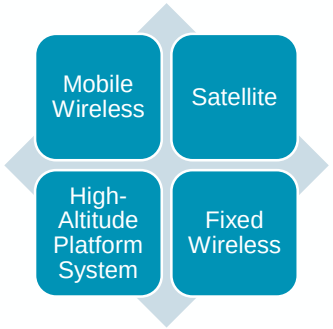
5G and Ligado's Mid-Band Spectrum

5G Vision

5G refers to a set of requirements and use cases:

- Enhanced Mobile Broadband (eMBB)
  - *High data rates, spectral efficiency, high traffic density*
- Massive Machine Type Communications (mMTC)
  - *High connection density*
- Ultra-Reliable Low Latency Communications (URLLC)
  - *Super low latency, 99.999% reliability*

Heterogeneity of needs requires a "network of networks" and more available spectrum in every band category



Band Categories
Low Band (<1 GHz)
Lower Mid-Band (1-2 GHz)
Higher Mid-Band (2-6 GHz)
High Band (mmWave)

Global push by carriers, infrastructure providers, technology companies, standards bodies, regulators, and most importantly countries to be leaders in 5G

Ligado's Role in 5G Vision

Greenfield Spectrum

40 MHz of flexible licensed spectrum in the lower mid-band that can enable faster and more efficient deployment of 5G networks

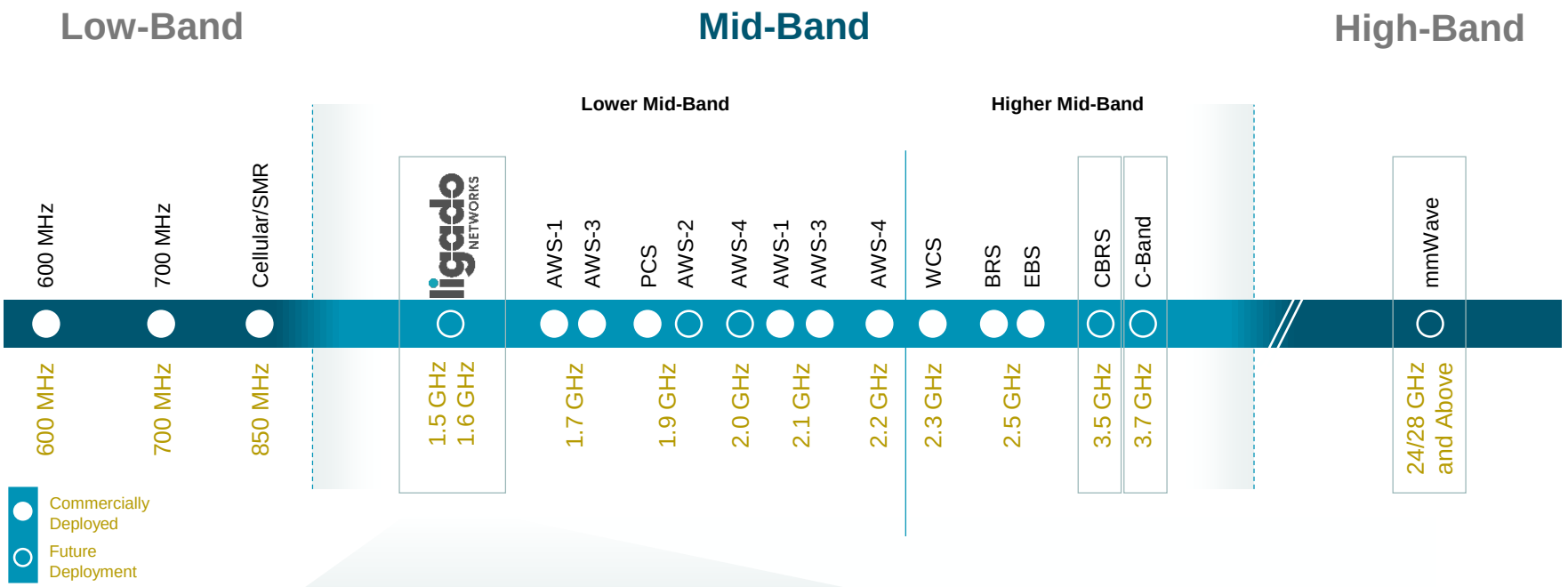
Satellite

State-of-the-art satellite that provides coverage throughout North America, delivers connectivity to small form factor devices, and will support network redundancy/remote coverage for IoT

Technology / Ecosystem

Development in process with leading technology vendors for base stations, deployment analysis, band standardization / commercialization, and standards-based technology for satellite IoT

L-Band is Among the Key Spectrum Bands in the Near Term Pipeline



KEY L-BAND FEATURES

Optimal Balance of Coverage and Capacity	Rapid and Easy Ecosystem Adoption	Globally Coordinated

Ligado's plan can deliver 40 MHz of lower mid-band spectrum

Lower Mid-Band Spectrum Plays a Critical and Complementary Role in 5G

		Low-Band (< 1 GHz)	Lower Mid-Band (1 – 2 GHz)	Higher Mid-Band (2 – 6 GHz)	High-Band (mmWave)
Spectrum Flexibility and Usability	Macro	●	●	◑	○
	Micro	●	●	●	○
	Small / Indoor	○	●	●	●
	Broad-Based Mobility	●	●	◑	○
	In-Building Penetration	Effective	Effective	Limited	None
Global Spectrum Availability		**600 MHz**	**None**	**CBRS, C-Band**	**24 GHz, 28 GHz, 37 GHz, 47 GHz**
		**700 MHz**	**1.4 - 1.5 GHz***	**3.4 - 3.8 GHz**	**24.5 - 27.5 GHz**
		**None**	**1.4 - 1.5 GHz***	**3.3 - 3.6 GHz, 4.8 - 5.0 GHz**	**24.5 - 27.5 GHz 37.5 - 42.5 GHz**

*1427-1518 MHz was allocated/identified in World Radio Conference 2015 for mobile services in all ITU regions and countries except US

Because not all spectrum is the same, a heterogenous spectrum portfolio is needed to fulfil the heterogenous needs of 5G

1675-1680 MHz Can be Shared and NOAA's Operations Fully Protected

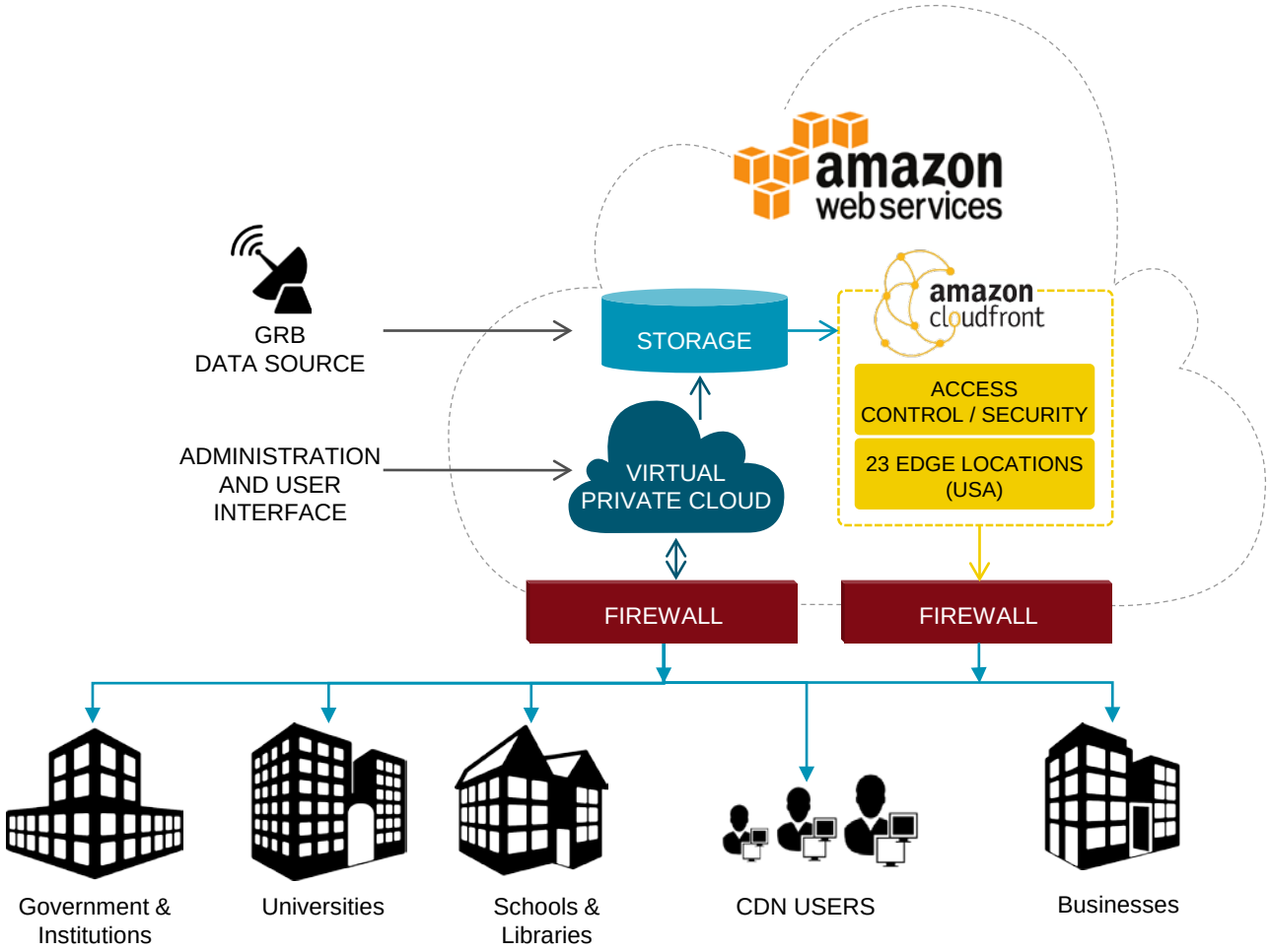
- The 1675-1680 MHz band can be unlocked for wireless broadband while at the same time ensuring that neither NOAA nor any other entity that accesses NOAA's weather data suffers harm.
  - The spectrum was first identified for auction in the FY 2014 President's Budget.
  - The FY 2020 Budget calls for the auction of the spectrum at a value of $600 million.
- NOAA's use is protected:
  - A study by Alion Science and Technology, an independent consulting firm selected in consultation with NOAA, demonstrates that NOAA's operations in the 1675-1680 MHz band can be protected through the establishment of geographic protection zones.
  - Ligado's proposed use of the band would respect these protection zones.
- Use by non-NOAA entities is protected:
  - To resolve any potential impact to the small number of non-NOAA users of data transmitted in this band, Ligado proposes that the Commission require the new commercial licensee of 1675-1680 MHz to provide the NOAA data via a cloud- and fiber-based content delivery network (CDN) using "push" technology.
  - Ligado has purchased a NOAA-compatible satellite receiver and dish system similar to those used by all non-NOAA users and developed a CDN, using an established cloud service provider, to deliver NOAA's weather data through the cloud and via fiber optic links.
  - After over a year operating the system, Ligado can report that the CDN is running according to the August 2016 plan and is delivering to George Mason University and the University of Oklahoma the same data NOAA currently provides in a timely and highly reliable manner.

Study Shows that NOAA's Earth Stations Can Be Protected

(Protection zones indicated are based on NOAA operations as of July 2019)

A CDN Can Effectively Deliver NOAA Information to Non-NOAA Users

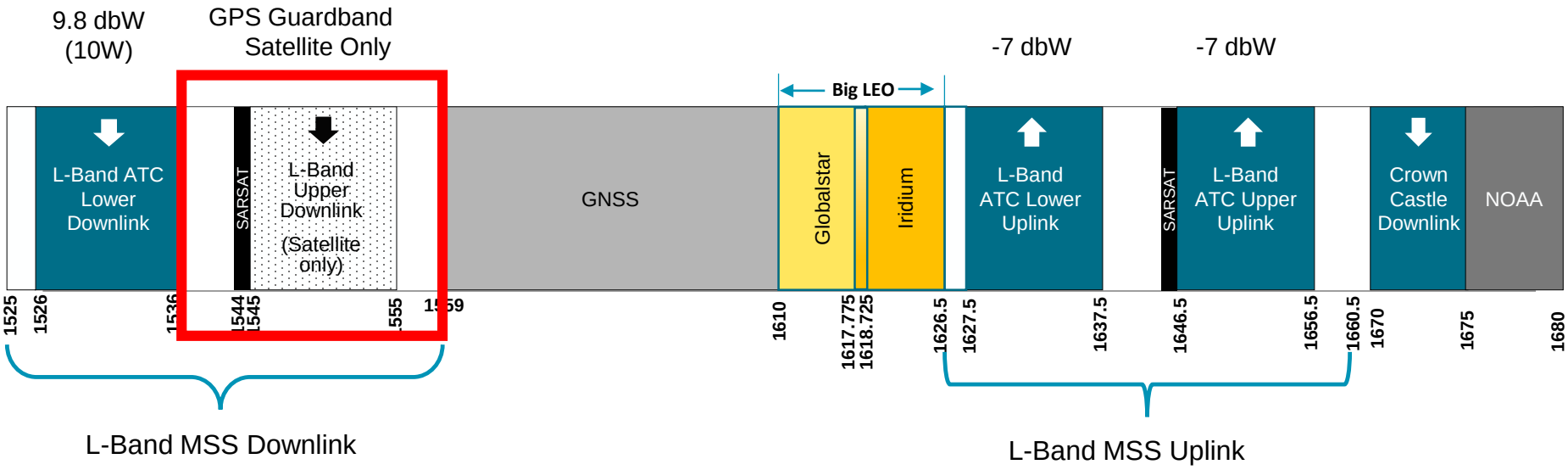
- Cloud-based
- Ability to store and push high volumes of data
- Highly reliable
- Highly scalable
- Highly secure
- Access via either standard internet connection or private fiber connection(s)
- Virtually no up-front costs for end users



A CDN Will Accomplish Public Interest Goals Identified in the Draft NPRM

NPRM Objective	Accomplished By CDN?
Non-NOAA users “continue to have access to” information from GOES satellites	Yes.
Data from the GOES satellites “made broadly available to the public”	Yes.
“Increase the total number of users with reliable access” to GOES data	Yes.

Ligado's Current L-Band Plan



Current Spectrum Plan Protects GPS:

- 23 MHz guardband created for GPS; Ligado agreed to use 1545-1555 MHz for satellite only
- Lower power in all channels; improved OOBEs
- Certified aviation devices (safety of life) protected by power level of 9.8 dBW (10W) in the lower downlink as requested by FAA and DOT

Chart not to scale.

Ligado Has Resolved All Concerns Raised in the Record

Government Use of GPS	• Ligado has committed to mitigate any impact on U.S. government GPS devices, including the repair or replacement of such devices as necessary, both pre- and post-deployment.
Commercial Use of GPS	• Co-existence agreements with the five major GPS device manufacturers, thousands of hours of testing at NASCTN, and Ligado's adoption of the power level recommended in the DOT Report confirm and ensure that Ligado's proposed terrestrial operations will not cause harmful interference to commercial GPS devices.
Complaints Raised by Iridium	• DOD-sponsored analysis by Alion concluded that Ligado's proposed terrestrial operations will not cause harmful interference to Iridium's operations by government and commercial users. • Ligado analysis in the record shows the same thing.
Commercial Use of SATCOM	• Inmarsat is developing a commercial and technical plan to address any potentially necessary retrofitting; all aviation stakeholders are involved in the development and approval of this new technology.

The NTIA Roadmap Seven Years Later: GPS is Protected as NTIA Anticipated in 2012

2012 NTIA Proposal	Action Taken	Status
Modify operating parameters to reduce impacts on GPS receivers to an acceptable level	• Ligado modified its operating parameters to satisfy GPS industry that co-existence would not harm GPS	✓
GPS receivers used in cellular and personal/general navigation GPS receivers can be designed to be compatible with the lower 10 MHz base station signal and deployed *over time* without disrupting user requirements.	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network • Resilient receivers are available in the market today	✓
NTIA to request FAA update standards	• Ligado worked with the FAA to develop a plan to protect all certified aviation devices; Ligado's proposal protects safety of life applications	✓
NTIA to lead review of receiver requirements	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network	✓
NTIA to urge FCC to *mitigate GPS receiver impact on full spectrum utilization*	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network	✓
PNT EXCOM to develop and establish new GPS interference standards that *strike a balance* between interference caused by transmitters and the performance of GPS receivers	• Ligado worked directly with GPS companies to ensure receiver co-existence with Ligado's network • All testing shows that the overwhelming majority of non-certified GPS devices will co-exist with Ligado's network, and the remaining devices can economically be modified or replaced	✓

Summary

5G requires an "all of the above" spectrum strategy – increased spectrum availability in all four band categories (Low, Lower Mid-Band, Higher Mid-Band, and High)

Many other nations have identified new spectrum for mobile services in lower mid-band, higher mid-band, and mmWave, but the 1427-1518 MHz band (lower mid-band) is not available in the U.S.

Countries that have both lower and higher mid-band spectrum will secure a significant advantage in the speed and cost of deployment as 5G networks are rolled out

Ligado has resolved concerns from the GPS industry and other stakeholders as well as concerns related to use of the 1675-1680 MHz band

The Ligado 40 MHz (35 MHz + 5 MHz) opportunity is in the globally coordinated L-Band and fills an important spectrum gap that would otherwise hinder the U.S. in the global race to 5G